

PATENT ABSTRACTS OF JAPAN

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(54) RADIO LOCAL AREA NETWORK IMPROVED IN CARRIER DETECTION

(57)Abstract:

PROBLEM TO BE SOLVED: To avoid collision, to enhance the availability of a common channel medium and to reduce the powder consumption of a mobile station by allowing a network station to set suspension threshold that suspends the transmission for a data

signal when a signal that exceeds threshold is received to higher sensitivity than carrier detection threshold that performs receiving processing when the signal that exceeds threshold is received.

SOLUTION: Mobile network stations 18 receive a signal on time slot base during a receiving mode and a carrier detection threshold circuit 70 and a suspension threshold circuit 72 decide the energy level of an incoming signal. When the circuit 72 detects a signal whose level exceeds threshold, it outputs a suspension instruction signal which notifies that sending can not be performed to prevent collision to a signal processing circuit 76. When a signal level increases and the circuit 70 detects a signal whose level exceeds threshold, it outputs a detection signal to the circuit 76 and the circuit 76 starts receiving processing.

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CLAIMS

[Claim(s)]

[Claim 1] It is the approach of operating a wireless local-area network station. This approach The phase of establishing a Carrier Detect threshold level, and the phase of establishing an adjournment threshold level, The phase of receiving the carrier signal which has corresponding power signal level, and the phase of transmitting a signal when this power signal level is lower than this adjournment threshold, The approach characterized by consisting of a phase of processing this carrier signal for these network stations when this power signal level is higher than this 1st Carrier Detect threshold level.

[Claim 2] It is the approach characterized by consisting of a phase where this approach changes this Carrier Detect threshold level and this adjournment threshold level further in an approach according to claim 1.

[Claim 3] It is the approach characterized by consisting of a phase where this approach establishes this Carrier Detect threshold level on level higher than this adjournment threshold level further in an approach according to claim 1.

[Claim 4] It is the approach characterized by consisting of a phase where this approach establishes this Carrier Detect threshold level on level almost equal to this adjournment threshold level further in an approach according to claim 1.

[Claim 5] It is the approach characterized by consisting of a phase where this approach establishes this Carrier Detect threshold on level lower than this adjournment threshold level further in an approach according to claim 1.

[Claim 6] This approach is an approach characterized by consisting of a phase which chooses Carrier Detect threshold signal level so that the communication link cel in which two or more migration network stations communicate with a predetermined base station inside further in an approach according to claim 1 may be defined.

[Claim 7] The phase of establishing this adjournment threshold level in an approach

according to claim 6 is an approach characterized by consisting of a phase of establishing adjournment threshold signal level so that it may become almost equal to the power level in alignment with the power-distance curve of the station located in one periphery of this communication link cel in the distance mostly located in the opposite hand of this communication link cel.

[Claim 8] The approach characterized by the size of this communication link cel being the function of this Carrier Detect threshold and this adjournment threshold in an approach according to claim 1.

[Claim 9] It is the wireless local-area network station which can transmit and receive a signal within a communication link cel. This network station It consists of a Carrier Detect threshold circuit constituted so that the carrier signal which has power signal level might be received. This Carrier Detect threshold circuit It is almost equal to the Carrier Detect threshold parameter with which this power signal level was specified, or is what generates a detection indication signal when larger than it. This network station consists of an adjournment threshold circuit constituted so that this carrier signal that has this power signal level might be received further. This adjournment threshold circuit Postpone and come, and it is, and is almost equal to a value parameter, or is the thing as which this power signal level was specified and which generates an adjournment indication signal when larger than it. This network station consists of a digital disposal circuit combined with this Carrier Detect circuit and this adjournment threshold circuit further. So that the signal with which this digital disposal circuit answered this Carrier Detect indication signal, and was received by this network station may be processed, this digital disposal circuit may answer this adjournment indication signal and transmission of the signal by this network station may be postponed The wireless local-area network station characterized by receiving this Carrier Detect indication signal and this adjournment indication signal.

[Claim 10] The network station characterized by this Carrier Detect threshold level and this adjournment threshold level being adjustable in a network station according to claim 9.

[Claim 11] The network station characterized by this Carrier Detect threshold level being higher than this adjournment threshold level in a network station according to claim 10.

[Claim 12] The network station characterized by this Carrier Detect threshold level being almost equal to this adjournment threshold level in a network station according to claim 10.

[Claim 13] The network station characterized by this Carrier Detect threshold level

being lower than this adjournment threshold level in a network station according to claim 10.

[Claim 14] The network station characterized by being almost equal to the power level in alignment with the power / distance curve of the station to which this adjournment threshold level is located in one periphery of this communication link cel in a network station according to claim 9 in the distance mostly located in the opposite hand of this communication link cel.

[Claim 15] The network station characterized by the size of this communication link cel being the function of this Carrier Detect threshold and this adjournment threshold in a network station according to claim 9.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to utilization of the extended media-access-control function to use at least two signal level thresholds for a detail, about a wireless data telecommunication system.

[0002]

[Background of the Invention] Current marketing of the wireless local area network is developed and carried out in order to avoid the need for the cable cable splicing between the stations of a local area network (Local Area Network:LAN). Such a

wireless local area network uses two or more migration network stations which are the data processors (personal computer etc.) which have radiocommunication capacity.

[0003] In the network by the cable, collision detection can be attained comparatively easily. However, in the case of the network by the wireless which uses one channel, since the dynamic range of a received signal level is large, it is quite difficult [it] to detect a collision. Therefore, a wireless local area network usually uses a collision-avoidance scheme instead of collision detection.

[0004] The wireless local area network (LAN) is constituted based on the media-access-control (MAC) method using a scheme like CSMA/CA (carrier Chita pile access accompanied by collision avoidance) currently explained by IEEE802.11 specification generally "is heard before talking (listen-before-talk)." According to one example explained by IEEE802.11 specification, the access point which functions as a base station, and two or more of other network stations are contained in a wireless local area network. The network station in a group or a cel communicates with those corresponding access points directly. This access point transmits a message to the destination station in the same cel, or transmits it to other access points through a cable distribution system, and a message is eventually transmitted to a desirable destination station from there.

[0005] According to the media-access-control (MAC) method, if each local-area network station judges that other stations have not transmitted signal transmission, it will start transmission. For this reason, each station postpones transmission of a signal, as long as it is higher than the receiving threshold level as which the signal level received from other stations was specified. That is, it prevents that a media-access-control (MAC) method starts the signal transmission in which the 2nd game which separates from the 1st game and is located overlaps the transmission started by the 1st game before and a time amount target. Usually, the 2nd game postpones the period signal transmission chosen at random.

[0006] The Carrier Detect turn around time (carrier ditECTIONtunaround time) of a very short period is fundamental for this random standby property. For example, IEEE802.11 DSSS (Direct Sequence Spread Spectrum:DSSS (direct sequence diffuse spectrum)) specification needs the slot-ized random standby behavior based on the 20-microsecond (microsecond) time slot for Carrier Detect turn around time.

[0007] Furthermore, the media access control (Medium Access Control:MAC) explained by IEEE802.11 specification needs one signal threshold level to the two modes, reception and adjournment. The minimum level of a receiving threshold is also

the level used for adjournment. Therefore, a receiver suspends transmission, when exceeding a receiving threshold and detecting the signal of an and also [it is of some kind]. IEEE802.11 DSSS Specification is [at -70dBm , the transmitted power 50, or 100mW] equal to -80dBm with less than 50mW of transmitted power -76dBm and 100mW of transmitted power, and 1W , or specifies from it the adjournment threshold which must be high sensitivity.

[0008] Reference of drawing 1 shows and explains the approach of the conventional technique of offering collision avoidance. That is, IEEE802.11 CSMA / CA protocol is designed so that the collision possibility between the stations of a large number which access a medium at the point which is the easiest to generate may be reduced. The possibility of a collision becomes [be / it / under / activity / of a medium / continuation] the highest at the event immediately after a medium will be in idle status. This is because many stations were waiting for a medium to become available again. Therefore, in order to solve contention contention of a medium, a random back-off method is used. Super-short period of time Carrier Detect turn around time is fundamental to those who became skillful in this work technical field for this random standby property so that clearly. Furthermore, IEEE802.11 media access control (MAC) defines the option about medium reservation by the point coordinate of a RTS/CTS (Request-To-Sender/Clear-To-Send: Request-to-Send/ready for sending) polling dialogue and time amount limited service. As shown in drawing 1, after during the medium activity middle, all wireless LAN equipments must stand by during the so-called inter-frame spacing (Inter Frame Spacing:IFS) period, and as long as there is no transmission of after that others, after a required random number carries out slot time standby, they can try transmission.

[0009] the reuse of a common channel medium -- being related -- IEEE802.11 DSSS although specification specifies a permissible prehension property -- this -- more -- low -- the activity of a sensibility adjournment threshold is enabled and it concludes in better medium reuse conditions. However, that an adjournment threshold becomes low sensibility more means that the range where breakage of transmission is prevented becomes small. In the network of the access point base, and the extraordinary network by the server station, traffic goes an access point or a server station in and out. The minimum receiving level which an access point / server station, and its assigned station receive mutually is difficult to predict because of [for multi-pass phasing and a shadow effect] change of the distance of the migration network station from an access point.

[0010] Therefore, in consideration of receiving well by the low, the improved need for

medium access equipment of offering common channel medium reuse high enough and power consumption low enough exists.

[0011]

[Summary of the Invention] This invention offers the media-access-control (MAC) method each station of whose in a local area network improved by using two variable parameters. One parameter is called the Carrier Detect threshold for receiving a desirable signal. A Carrier Detect threshold is the level of the carrier signal with which a network station does not tend to deal with a data signal and which is observed in a value lower than it. For example, by changing a Carrier Detect threshold, if it is exceeded, a signal is able to choose the signal level received and processed. The 2nd parameter is called an adjournment threshold. An adjournment threshold is the level of the carrier signal with which a network station postpones transmission of a data signal and which is observed, when it is exceeded.

[0012] Since according to one example of this invention an adjournment threshold is constituted so that it may become high sensitivity from a Carrier Detect threshold, all the stations that wish transmission of a data signal postpone signal transmission, as long as there are other network stations or access points which transmit a data signal. The required prehension ratio for the desirable cell size of a wireless local area network and good reception is a part of parameter which determines the parameter of a Carrier Detect threshold and an adjournment threshold. A medium reuse becomes good, so that the sensibility of an adjournment threshold is low. The capacity which covers a long distance by low traffic reinforcement is combinable with optimization of a set network throughput by choosing suitable adjournment and a Carrier Detect threshold by this approach.

[0013] desirable -- being alike -- according to one example of this invention, the same adjournment threshold is used about all stations including the access point where the cel range corresponds.

[0014] However, since a Carrier Detect threshold is selectively changed about each station, please understand an advantageous thing. if another word is carried out and a Carrier Detect threshold will be high sensitivity -- a transmitter-receiver chip -- a Carrier Detect threshold -- low -- it will process more frequently than the case, sensibility. Since the low sensibility Carrier Detect threshold is taking into consideration reduction of the power consumption of a dc-battery, it is advantageous, but this is important for the migration network station which operates with a dc-battery so that clearly [those who became skillful in this work technical field].

[0015] Although this invention is explained below, referring to an attached drawing,

this is only a thing as mere instantiation.

[0016]

[Detailed description of invention] Reference of drawing 2 shows the desirable example of the wireless local area network (LAN) 10 by which this invention is realized. The access point 12 which functions as having explained above as a base station is included in a local area network 10. However, this invention is not restricted at this point and can use the local area network using the server office which sends and receives a message to a network station of other classes. An access point 12 is connected with other equipments and/or network where the network station in LAN10 can communicate. In an access point 12, the antenna 16 constituted so that a communication channel might be led and a data signal might be transmitted and received is contained.

[0017] The mobile station 18-1 which has an antenna 20 respectively, and a migration network station 18 called 18-2 are contained in a network 10 again. Although a direct sequence diffuse-spectrum (DSSS) modulation can be used for a mobile station and a message can be selectively transmitted and received by 1 Mbit/s (megabits per second) or 2 Mbit/s, this invention is not restricted to that range at this point. The Carrier Detect threshold circuit 70 and the adjournment threshold circuit 72 which can receive a signal via an antenna 20 are included in each mobile station 18. Memory 74 is constituted so that come, it may be [it may expect a Carrier Detect threshold parameter and a total,] and the numeric value of a value parameter may be saved. The output port of memory 74 is combined with the input port of the Carrier Detect threshold circuit 70. Similarly, another output port of memory 74 is combined with the input port of the adjournment threshold circuit 72. That is, memory 74 provides the Carrier Detect threshold circuit 70 corresponding to a desirable Carrier Detect threshold parameter with a signal. Memory 74 provides the desirable adjournment threshold circuit 72 corresponding to [postpone and come, are and] a value parameter with a signal similarly.

[0018] The digital disposal circuit 76 constituted so that the signal received by the antenna 20 might be processed further is contained in the migration network station 18. A digital disposal circuit 76 also processes the signal transmitted by the migration network station with an antenna 20 again. The input port of a digital disposal circuit 76 is constituted so that a detection indication signal may be received from the output port of the Carrier Detect threshold circuit 70. Similarly, another input port of a digital disposal circuit 76 is constituted so that an adjournment indication signal may be received from the output port of the adjournment threshold circuit 72. Since the

output port of a digital disposal circuit 76 is combined with the input port of memory 74, it can postpone with the Carrier Detect threshold parameter saved in memory 74, and can be [can come,], and the numeric value of a value parameter can be changed. [0019] According to one example of this invention, although each migration network station 18 receives a data signal with the time-slot base between the signal receive modes, this invention is not restricted to that range at this point. A Carrier Detect threshold circuit and an adjournment threshold circuit judge the energy level of a terminating signal during the time-slot period of 20 microseconds. The Carrier Detect threshold circuit 70 supervises the incoming-data signal received by the antenna 20. If the carrier signal exceeding a Carrier Detect threshold parameter of an energy level is detected, the Carrier Detect threshold circuit 70 will provide a digital disposal circuit 76 with a detection indication signal. Answering it, a digital disposal circuit 76 starts processing of the signal received by the antenna 20. Also when the energy level of the received signal postpones, comes and is and exceeds a value parameter, the adjournment threshold circuit 72 provides a digital disposal circuit 76 with the adjournment indication signal which tells a migration network station about the ability not to transmit, in order to avoid the collision on the communication channel used by the local area network 10.

[0020] Reference of drawing 3 shows the situation of the isolated cel from a viewpoint of an access point 12. The carrier signal level observed by the migration network station which separates from an access point 12 and is located is shown by the curve 29 as a function of the distance of the network station from an access point. A curve 29 is determined by the path loss property of the transmitted power used in an access point, and this environment. The capacity of the receiver of the station in the isolated cel is determined by Carrier Detect threshold like the Carrier Detect threshold shown by a straight line 32-1 or 32-2. As reference was made before, a Carrier Detect threshold level is defined by the value lower than it as the LAN station 18-1 and carrier signal level to which 18-2 does not process an incoming-data signal. The Carrier Detect threshold level 32-2 is distance so that it may be illustrated. - Intersecting a curve 29 by R2 and +R2, the Carrier Detect threshold level 32-1 is distance. - A curve 29 is intersected by R and +R. The distance to which the straight line of a Carrier Detect threshold level intersects the curve of carrier signal level determines the boundary of a local area network cel where a migration network station can communicate with an access point 12.

[0021] If the Carrier Detect threshold 32-1 becomes high sensitivity more lower so that clearly, actuation and reception in the larger range will be attained. The cel

produced as a result of using the Carrier Detect threshold level 32-1 is shown as a cell 28. The cell which similarly is produced as a result of using the Carrier Detect threshold 32-2 is shown as a cell 30. The network station which operates with the Carrier Detect threshold 32-2 is understood that sensitivity is lower than the network station which operates by the Carrier Detect threshold level 32-1.

[0022] A range of number significant for a Carrier Detect threshold level has a low boundary rather than it is determined by the sensitivity of a receiving circuit. For example, if a Carrier Detect threshold is set as a low numeric value, the attempt of much meaningless reception will be performed and it will conclude in the high rate of failure on parenchyma. more -- low -- by using a sensitivity Carrier Detect threshold parameter, a local-area network-of-network office can operate within smaller cell size. in case such small cell size takes the possibility of the reuse of the same channel into consideration in the comparatively small range, it is desirable -- it comes out. On the contrary, in a lower high sensitivity Carrier Detect threshold level, it can operate in the larger range.

[0023] Reference of drawing 4 shows the relation with a desirable Carrier Detect threshold level shown according to one example of this invention as the adjournment threshold level shown as a straight line 38, and a straight line 32-2. Although the situation that an adjournment threshold is set as level lower (high sensitivity) than a Carrier Detect threshold is shown by drawing 4, this invention is not restricted to that range at this point. For example, according to other examples of this invention, a Carrier Detect threshold and an adjournment threshold may be changed so that they may attain the same level on parenchyma or a Carrier Detect threshold may become lower than an adjournment threshold.

[0024] According to one example of this invention, in order to determine the adjournment threshold to a predetermined Carrier Detect threshold, it must be taken up in distance R2 and the curve 33 corresponding to the carrier signal power must be plotted for an office called 40 of one side face of a cell as a function of the distance from an office 40. That is, a curve 33 shows the graph of level which is too called a carrier signal curve and with which the carrier signal received from the station 40 as a function of distance was observed. In the case of this example of this invention (+R2 [for example,]), the level which a curve 33 intersects on another side face of a cell defines the adjournment threshold level identified as a straight line 38.

[0025] Therefore, when there is transmission from an access point 12, the level which which station of the range of gray answers is over the Carrier Detect threshold level 32-2. That is, all stations only receive what is transmitted in a circle or cell size 30.

However, if the level is exceeded, the level of the carrier signal with which each station postpones transmission and which is observed will be set up by the adjournment threshold level 38.

[0026] the media-access-control equipment shown by drawing 4 -- being the so-called -- hiding -- terminal problem (hidden terminal problem) It removes on parenchyma. It hides, and a terminal problem is generated when two terminals which cannot be observed transmit a message to the 3rd terminal like an access point simultaneously. At this 3rd terminal like an access point 12, two signals interfere mutually and common channel interference is generated. As for the 3rd terminal, receiving one of the two messages loses two messages at the sacrifice of as hard as possible and precious bandwidth in many cases.

[0027] However, if the media-access-control equipment of drawing 4 is used, the office in one periphery of a cel will be postponed for the office of another most distant periphery of a cel. As explained above, this plots the curve about one periphery station, and when making it adjournment level certainly intersect this curve in other cel peripheries, it is attained. By choosing this level, all stations wait for and postpone each other, and the local area network to which each station communicates with an access point 12 is offered. Consequently, it hides in the group of the station belonging to a cel, and a terminal problem is removed on parenchyma.

[0028] The range of an adjournment threshold has the low boundary determined with the sensibility of a Carrier Detect circuit. When lower than a certain level, a signal is not detected and adjournment is not performed. The desirable relation shown in drawing 4 cannot be attained when set as the lowest high sensitivity level in which the Carrier Detect threshold 32-2 is possible. In this case, the lowest significant adjournment threshold does not guarantee the required adjournment between two "a periphery and offices" as shown in drawing 5.

[0029] Selection of the numeric value of a low Carrier Detect threshold forms the big cell size of a radius R34, as shown in drawing 5. When the lowest significant adjournment is plotted, the range which mutual adjournment generates has the small size shown in the small circle which has a radius R36. If this combination of a threshold is used, a network station can hide using the channel access equipment called a Request to Send / ready-for-sending (RTS/CTS) medium reservation device, and can avoid an office phenomenon on parenchyma. Apply this channel access equipment to the publication of this description by citation. R. O.La Maire, A.Krishna, and P.Bhagwat, J. -- Panian -- "-- wireless LAN and migration networking: -- specification and future direction (Wireless LANs and Mobile Networking:Standards

and Future Direction)" -- It is explained more to the detail by (the U.S. electrical-and-electric-equipment IECE communication link journal (IEEE Communication Magazine), Vol.34, No.8 (August, 1996), the 86th page, or the 94th page).

[0030] Reference of drawing 5 calls the sum total cel range 60 the basic coverage range (Basic Coverage Area:BCA). When this vocabulary is used, the range 62 of the smaller one is called the common coverage range (Shared Coverage Area:SCA), and it is shown in this range that the medium common regulation by this invention is effective. With desirable equipment, the common coverage range SCA is almost equal to the basic coverage range BCA.

[0031] When forming the cellular infrastructure system which has the threshold which the above for control of a low receiver and a transmitter defined, it is clear to those who became skillful in this work technical field that suitable balance with a roaming threshold should be maintained so that it may discuss below. When opting for transmission/receiving behavior of the station and access point where the Carrier Detect threshold 32-2 and the adjournment threshold 38 belong to the same cel, a roaming threshold level determines the flash when a migration network station opts for initiation or a halt of the participation to a cel. A network station should care about setting capacity of the receiver by which current setting out was carried out as the foundation of the hand-over decision. That is, when small cell size is required, a roaming threshold must be set up so that retrieval of a new access point may be started before the event of it becoming impossible physically for a receiver to receive a message from the present access point.

[0032] Furthermore, according to the principle of this invention, it is possible to define the variable cell size which leads to the capacity which controls the consistency of the cel which covers a certain range directly, or an access point. If it pulls, it means a better sum total throughput from that of the same channel that many small cels are in a certain range as many reuses, rather than there is a small number of big cel.

[0033] In order to set up a Carrier Detect threshold and an adjournment threshold, according to this invention, by using an adjustable threshold, it is possible to reduce cell size and to increase the reuse of the same frequency in a certain range. One approach which reduces cell size is reducing the transmitted power of each access point. Since another approach raises the layer of Carrier Detect and an adjournment threshold according to the example as instantiation of this invention discussed above, it is advantageous. That is, each station disregards the signal of the cel range and tries most for it in order that it may be cautious of the signal for each stations.

Furthermore, since cell size is small, if it gets to know that the object receiver is within the limits of a small cel, each station will be tried so that a signal may be transmitted without postponing.

[0034] This invention is realized in the condition machine of a MAC control unit. A condition machine transmitter-receiver is used, and when the effective modem carrier signal of the receiving level exceeding a Carrier Detect threshold is detected, a transmitter-receiver considers that this is an effective modem carrier signal, and starts reception. When the receiving level of an effective modem signal exceeds an adjournment threshold, a transmitter-receiver reports that a medium is using it to a MAC control unit by activating a control line signal.

[0035] The example explained here [a desirable example and here / desirable] is only the object as instantiation, it should not be interpreted as what restricts the range of this invention, but the range of this invention is appropriately described by only the attached claim.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the plot of the timing chart showing actuation of carrier Chita pile access of the conventional technique by the collision-avoidance method.

[Drawing 2] It is the block diagram of the wireless local area network containing one access point and two migration network stations by one example of this invention.

[Drawing 3] It is drawing of a plot showing the power observed by the network station

as a function of distance when the corresponding access point by one example of this invention transmits a signal, and the effect of the Carrier Detect threshold level as two instantiation to the size of a local area network cel.

[Drawing 4] It is drawing of a plot showing the relation of the adjournment threshold and Carrier Detect threshold about a wireless local area network by one example of this invention.

[Drawing 5] It is drawing of a plot by one example of this invention showing the effect of buildup of the sensibility of a Carrier Detect threshold.